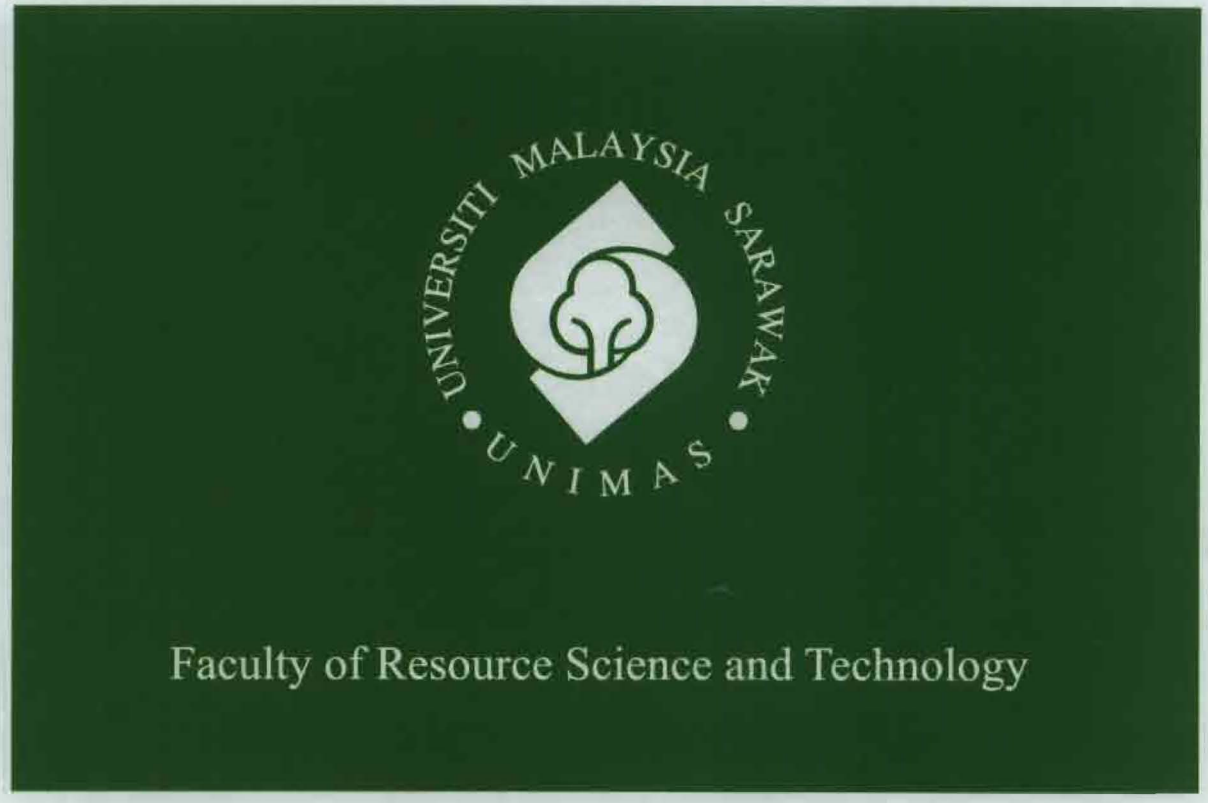

HEALTH ASSESSMENT OF *ARAUCARIA COLUMNARIS* AND *YUCCA ALOIFOLIA* IN UNIMAS

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Bachelor of Science with Honours
(Plant Resource Science and Management)
2015

Health Assessment of *Araucaria columnaris* and *Yucca aloifolia* in UNIMAS

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This report is submitted in partial fulfilment of the
requirement for the Degree of Bachelor of Science with Honours
(Plant Resource Science and Management)

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2014/2015

DECLARATION

I hereby declare that the thesis is based on my original work. All the quotations and citations have been duly acknowledge. No portion of the work referred to this dissertation has been previously or concurrently submitted for any other degree programs in UNIMAS or other institutions of higher learning.

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ACKNOWLEDGEMENT

First of all, I would like to say Alhamdulillah to Allah S.W.T for giving me an opportunity and strength to complete this thesis. I am grateful to all those concerned who had made this dissertation possible. I am very grateful to have Dr. Mohamad Hasnul Bolhassan as my supervisor, for his guidance, advices, knowledge and non-stop support to complete this study. His patience and understanding make me feel comfortable to complete this thesis. Throughout this project, I have learnt many experiences and skills that improving my knowledge.

I am also very thankful for having Dr. Siti Rubiah Zainuddin, as my examiner, for guidance, meaningful criticism, suggestion, and encouragement to complete this thesis with successful. Her patience and understanding make me feel comfortable to finish this thesis.

My special respect goes to my parent, En. Khair Yusof Bin Rahman and Pn. Tahaviah Binti Abd Manan and my siblings for giving support and encourage me to complete this project. My sincere thanks to my friend, Siti Nadhirah Ismail and also my roommates who show an interest in my project and help me through hard times and giving me idea and moral supports to full fill this project.

I would like to express my appreciation to UNIMAS landscaping unit management especially, En. Anis for the cooperation in technical support while carrying out this project. Thank you for the precious information about the urban tree management and applications.

My warmest thank also goes to my colleagues, course-mate for their endless love, help and support throughout my study in UNIMAS. Last but not least, thank you for the people that have involved directly and indirectly for complete this project with success.

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List of Abbreviations

CAIS	Centre for Academic Information and Services
CLS	Central Learning of Studies
cm	Centimetre
DBH	Diameter at Breast Height
m	Meter
SPAD	Soil Plant Analysis Development
UH	Universities Houses
UNIMAS	Universiti Malaysia Sarawak

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ABSTRACT

Urban trees planted in the urban landscape are usually beautiful, of high aesthetic values and should be free of pests and diseases. However, due to several abiotic and biotic factors, trees are sometimes infected with diseases and pests. In this study, the main objective is to assess the health status of *Araucaria columnaris* and *Yucca aloifolia* planted in UNIMAS campus and to identify the types of diseases associated with *Araucaria columnaris* and *Yucca aloifolia*. This study was conducted in UNIMAS campus. In this study, physical observation based on the height and diameters of breast height (DBH) were assessed. The Soil Plant Analysis Development (SPAD) meter is used to indicate relative chlorophyll content and the nitrogen concentration in the leaves. Thus, it providing accurate information and data analysis about the trees physiological status planted in an urban environment. *Araucaria columnaris* and *Yucca aloifolia* were evaluated for health status by measuring the chlorophyll content and observation on foliage and other physical features. The result shows that, there are fungus infestations, and termites attacked. Then, the infected tissues were isolated and inoculated to confirm the disease associated with it. The results obtained will then be recommended to landscaping unit in the trees maintenance for the proper management in future.

Key words: Landscape, *Araucaria columnaris*, *Yucca aloifolia*, disease, health status, chlorophyll content.

ABSTRAK

Pokok-pokok yang ditanam di dalam landskap bandar biasanya cantik, mempunyai nilai-nilai estetik yang tinggi dan seharusnya bebas daripada perosak dan penyakit. Walau bagaimanapun, disebabkan oleh beberapa faktor seperti abiotik dan biotik, pokok juga kadang-kadang dijangkiti oleh penyakit dan perosak. Di dalam kajian ini, objektif utama adalah untuk menilai status kesihatan Araucaria columnaris and Yucca aloifolia di dalalm kampus UNIMAS dan untuk mengenalpasti jenis penyakit yang berkenaan dengan Araucaria columnaris dan Yucca aloifolia. Kajian ini telah dijalankan di dalam kampus UNIMAS. Di dalam kajian ini, pemerhatian secara fizikal berdasarkan kepada ketinggian dan ukur lilit batang pokok telah dinilai. Penggunaan Soil Plant Analysis Development (SPAD) adalah untuk menunjukkan kandungan klorofil dan kepekatan nitrogen di dalam daun. Demikian kerana, ia memberikan maklumat dan data analysis yang tepat berkenaan status fisiologi pokok yanf ditanam di dalam persekitaran bandar. Araucaria columnaris dan Yucca aloifolia telah dinilai berkenaan status kesihatan melalui ukuran kandungan klorofil dan pemerhatian pada daun dan ciri-ciri fizikal yang lain. Keputusan kajian menunjukkan, terdapat infestasi kulat dan serangan anai-anai. Selepas itu, bahagian tisu yang dijangkiti akan diasingkan dan di inokulasikan untuk mengesahkan penyakit yang berkaitan dengannya. Keputusan yang diperolehi akan dicadangkan kepada pihak pengurusan dalam pengurusan pokok untuk menambahbaikkan pengurusan pada masa hadapan.

Kata kunci: Landskap, Araucaria columnaris, Yucca aloifolia, penyakit, tahap kesihatan, kandungan klorofil.

1.0 Introduction

Urban forestry is defined as the care and management of urban forests, for example the tree populations in urban settings for the purpose to improve the urban environment to secure multiple environments and give social advantages for urban dwellers (Miller, 1988). Urban forest plays an important role related to health, aesthetic and recreational benefits in industrialized cities. Urban trees are likely to increase in importance in ecological services in cities and towns by carbon sequestration, removing airborne pollutants, and controlling storm water runoff (Beckett et al., 2000).

There are many types of insects and diseases can infest ornamental trees. It can change the structure, appearances of the trees in the unwanted way and reduces the value of plant (Jones et al., 2001). The common diseases infest the trees are die back, powdery mildew, wood decay and foliage diseases (Elliott, 1999). Trees play an important role when it acts as reducing point–sources pollution and capture more of a larger size particular matter than the tree planted away from the road (Beckett et al., 2000).

The proper selection of trees for urban environment is crucial for successful establishment and well adapt to urban environment. According to Wen (1992), biological and genetic diversity is a main factor in the strength and disease tolerance of streets side tree population. This statement was supported by Li et al. (2011), as the study mentions greater aesthetic variation and healthier trees in urban areas it is because of broad species diversity. This is because, trees provide generous benefits including from physiological and economic benefits to the ameliorating of urban climate and mitigation of air pollution (Sreetheran et al., 2011). On the other hand, besides important environmental services such as air and water purification, wind and noise filtering or microclimate stabilization, natural

area it also offer social and psychological services, which are important significance for the liveability of modern cities and the well-being of urban residents (Chiesura, 2004).

Salleh *et al.* (1990) stated that, trees are grown and acts as screens which are to provide motorists with pleasant scenery by selectively blocking off unpleasant features. Conversely, the tree may be grown for the benefit of people living next to motorways to screen traffic dust and noise and to provide a nice view. Santamour (1990) recommended that, for maximum protection of an urban forest against pests either new or old is using formulas 10-20-30 which are urban forest should contain no more than 10% of any single tree species; no more than 20% of any species in any tree genus and no more than 30% of species in any tree family. Thus, the ornamental plants used in this study are *Araucaria columnaris* and *Yucca aloifolia.*

1.1 Problem statement

Urban trees planted in the urban landscape are usually beautiful, of high aesthetic values and should be free of pests and diseases. However, due to several abiotic and biotic factors, trees are sometimes infected with diseases and pests. Thus, it is of interest to assess the health status and the types of diseases and pests associated with *Araucaria columnaris* and *Yucca aloifolia* planted in UNIMAS.

1.2 Objectives

The objectives of this study are to assess the health status and to identify the diseases and pests associated with *Araucaria columnaris* and *Yucca aloifolia* planted in UNIMAS.

2.0 Literature Review

2.1 Benefits of urban trees

The urban trees provide huge number of benefits towards the humankind. The benefits that have been provided are aesthetic and recreations value and noise reduction.

2.1.1 Aesthetic and recreations value

Urban landscape become one of the places where people can gather together because it had created the landscape with integrating grasses, shrubs, and trees. Urban trees also provide aesthetic amusement and make a pleasant environment for different outdoor activities (Tyrväinen et al., 2005). There are some outdoor activities such as reading, listening to music, cycling, playing with friends and children, relaxing and picnicking or eating. In addition, by doing this it may help people to recover from daily stress, revive memories and regain confidence as well as the relationship with surrounding. It also can be one of platform in education for the people to learn about the nature and natural process in an otherwise artificial environment (Tyrväinen et al., 2005).

2.1.2 Noise reduction

The most hazardous environmental type of pollution is air (gas emission) and follows by water pollution (Khilman, 2004). Nowadays, noise pollution has including in this categories after the air and water pollution (World Health Organization, WHO). One of the factors that contribute to human stress is a noise surrounding that can cause painful and hearing damage. Urban tree with the proper design will be able to absorb, deflected, or refracted by the others part of tree such as leaves, twigs, and branches of trees and shrubs (Aylor, 1972; Miller, 1997). Trees also can soften urban noise almost as effectively as

stone walls and can convert it by generating enjoyable sound as wind moves tree leaves or as birds sing in the canopy (Miller, 1997).

2.2 Planting distances

Planting distance in the urban environment is the main aspect for the trees to grow into the healthy condition. A tree's ability to grow and stay healthy is dependent on availability of rooting space as it needs a larger space for the root system. In highly urbanised area where the largest number of trees presences in the small planting spaces with the little available soil and trees in this situation had tend to be short-lived, and generally never function as vibrant components of a city's infrastructure (Casey Trees project team, 2008).

The main cause for the poor performance of many urban trees is because of limited soil volumes and an increase of soil compaction. This is because the root cannot expand into the surrounding as well as normal. When these occur, the root will unable to absorb the water and nutrient as it cannot penetrate into the soil. In addition, if the roots cannot grow into the surrounding soil, it will be continued for growing until it destroys the roadside, concrete, and building. This will lead to the exceed amount of the soil capacity and the tree health will begin to reduce and finally it will die.

Besides the root space, the canopy of tree species also required ample space for its growth. When the space is limited, the trees will have a tendency to overlap between the canopies.

2.3 Pest and diseases of urban trees

There are many types of insects and diseases can infest urban trees. The normal function, structure, or appearance of the plant is disrupted or changed, usually in an unwanted way, reducing the value of the plant (Jones et al., 2001). This is because of the interaction

between the plant (host) and a living (biotic) or a non-living (abiotic) organism. Urban tree has their own problems and mostly all the parts of trees probably to be affected, such as foliage, shoots, branches, trunks, and roots (Magasi, 1995). Fungi, bacteria, nematodes, viruses and others are the types of pathogens which are also known as biotic organisms. Besides that, pathogens are infectious, which means that they can spread or be spread from plant to plant.

Abiotic diseases or disorders are non-infectious conditions, and the environmental, chemical, and mechanical are the three categories that be grouped together under it. The factors of environmental are the conditions such as extremes of temperature, lack or excess of moisture and lighting, whereas the chemical problem always termed as phytotoxicity. This is because of unfavourable pH of the soil or growth medium, nutrient problems, fertilizer injury, air pollution, or pesticide burns. Mechanical injury includes damage due to animals, insects, machinery and others.

2.3.1 Biotic factors

2.3.1.1 Fungi

Traditionally, a group of diverse microorganisms has been classified as fungi because of similar morphology and biology and a number of characteristics differentiate them from plants (Jacobs, 2001). Generally, fungi have fine, threadlike hyphae, intertwined to form the mycelium, which may be visible on the surface of infected plants. Spores are often produced by specialized hyphae that arise from the mycelium. Fungi exist primarily as decomposers or organic matter. However, fungi are capable of causing diseases in plants and animals in a small percentage. It also have been recognized with about 69,000 species, approximately 8,000 are plant pathogens. Most diseases of plants are caused by fungi then

follow by bacteria, nematodes, viruses, and pyhtoplasmas combined (Jacobs, 2001). The diseases cause by fungus is affected by its capacity in nutritional preferences, such as it uses dead tissue or living tissue as a food sources. Table 1 tabulated a classification of some common fungal pathogens of woody ornamentals and the diseases they cause.

***Table 1*: Classification of some common fungal pathogens of woody ornamentals and the diseases they cause.**

Kingdom and class	Example[a]	Diseases
Kingdom Fungi	*Armillaria*	Root rot, butt rot
Basidiomycetes	*Ganoderma*	Wood decay
	Gymnosporangium	Rust of junipers and plants in the family Rosaceae
	Rhizoctonia	Damping-off, web blight
	Sclerotium	Southern blight
Ascomycetes and most imperfect fungi		
Apothecial fruiting body	***Botrytis***	Gray mold
	Diplocarpon	Black spot of rose
	Entomosporium	Leaf spot
	Lophodermium	Needle cast
	Marssonina	Leaf spot
	Monilinia	Brown rot
Locular or stromatic fruiting body	***Alternaria***	Leaf spot, leaf blight
	Apiosporina	Black knot
	Botryosphaeria	Canker
	Septoria	Leaf spot
	Sphaeropsis	Tip blight, canker
	Venturia	Apple scab
Perithecial fruiting body	***Cylindrocladium***	Root rot
	Cytospora	Canker
	Discula	Anthracnose
	Fusarium	Damping-off, wilt
	Nectria	Canker
	Ophiostoma	Dutch elm disease
	Verticillium	Wilt
Cleistothecial fruiting body	***Aspergillus***	Stem, leaf, and fruit rots
	Sphaerotheca	Powdery mildew
No fruiting body	*Taphrina*	Leaf curl and blister
Kingdom Chromista		
Oomycetes	*Phytophthora*	Root rot, collar rot
	Plasmopara	Downy mildew
	Pythium	Damping-off, root rot

[a] Only a few common fungal pathogens are listed. The names of asexual (imperfect) fungi are in boldface type.

2.3.1.2 Bacteria

In late 1800, bacteria have been known as important plant pathogen, when fire blight on pears and apples was discovered as the cause of the bacterium. Later, it's recognized as *Erwinia amylovora.* Today, it remains as one of the most common bacterial diseases of woody ornamentals (Chase & Benson, 2001).

According to Chase and Benson (2001), the plants primarily will be attacked by the bacterial pathogen through wound or natural openings, i.e., stomates and hydthodes. Besides that, they also can survive in plant tissue for a long period of time in an inactive form, when the environmental conditions are suitable it will respond to diseases.

There are a variety of symptoms shows of the plant causes of bacterial diseases. However, it is depending on the particular pathogen and host involved, infected plants may have soft rots, galls, leaf spots, cankers, leaf and stem blight, wilts, or shoot and tip dieback. *Agrobacterium tumefaciens* is one of example, bacterial diseases that cause crown gall of roses and other plants that belonging to the family Rosaceae (Chase & Benson, 2001).

2.3.1.3 Plant-parasitic Nematodes

Tiny worms are known as plant-parasitic nematodes. Nematodes cause severe damage in sandy soil, but they are a problem in soil of all types. Dunn (2001) found that, an oral stylet or spear has been used by plant-parasitic nematodes to puncture host cell and released the enzymes for feeding on living plant tissue. This process will cause injury to plants.

Plant-parasitic nematodes can be grouped into two categorized: ectoparasites (feeding on plant tissue from outside the host) and endoparasites (feeding from within host tissue). The

symptoms of nematode disease are poor plant growth, chlorosis of foliage, poorly develop root systems, lesions on roots, and root galls (Dunn, 2001).

2.3.1.4 Viruses

A virus is made up of genetic material (DNA or RNA) that is protected by a coat of protein. Viruses are independent organisms as it cannot multiply on their own, but can multiply only within living cells. Virus needs a transport that called a vector to help them move into the plants or through injury. The example of virus vectors is insects, mites, nematodes, fungi, and parasitic plants. In woody ornamental, viruses are subtle, and they are challenged to cope with, because they are spread so readily by vegetative propagation (Brown & Bliss, 2001).

Brown and Bliss's (2001) stated that, symptoms of the viruses can be difficult to guide for diagnosis, because similar symptoms can be produced by different viruses. Virus infections are extremely variable in their symptoms. Uniformly discoloured in certain leaf parts are a cause of some virus infections. Then, malformations can distort, dwarf, and thicken leaves and cause them to curl upward and downward are resulting from the virus infection. Virus-infected fruits and roots may be discoloured and may have necrotic lesions. Flowers are similarly affected, with distortions, dwarfing, and the formation of abnormal parts. Fruits may be dwarfed or deformed and may have tumorous swellings or aborted seed. The stem may also be distorted and shortened internodes. Next, roots may decay and die back and tumours may form or a proliferation of side roots in the absence of other pathogens.

Wilting, defoliation, premature leaf drop, deviation in flower number, delaying or premature flowering, gummosis, bark scaling, and graft incompatibility are the symptoms of viral that can be confused with other pathogens (Brown & Bliss, 2001).

2.3.1.5 Termite

Termites are known as an important group of insects in Malaysia (Lee, 2002) and also the major pests in the urban forests, agricultural and forest environment (Dhanarajan, 1969; Tho, 1992). Termite infestation is a major problem to residential premises in Malaysia (Lee, 2002) which are about 180 species of termites has been found in Malaysia, covering a total of 42 genera (Tho, 1992). Two species of termites that are highly causes destructive to urban tree are known as *Coptotermes curvignathus* and *C. gestroi* (Cowie *et al.*, 1989). Besides, *Coptotermes* species there are several other termite pests are also readily found, and these include *M. gilvus, M. carbonarius, G. sulphureus, M. pakistanicus, Odontotennes* spp. and *Microcerotermes*. Among these species, *M. gilvus, M. carbonarius* and *G. sulphurous* are mound-builders, while *M. pakistanicus* may sometimes be found in mounds of *M. gilvus* and *M. carbonarius.* On the other hand, *M. crassus* is an arboreal nest builder. Most of them attacked small wooden structures and trees around the houses (Lee, 2002).

2.4 Nutrient stress

Nutrient stresses take the form of toxicity or deficiency and have attracted the attention of plant physiologists and crop production scientists for many years. Concentration of nutrient in plants varies with age, plant part, species, and the rooting medium or soil type. Nutrient deficiency can be detected by its symptoms which are any perceptible change in known structure, appearance, or function (Table 2). For example, the yellowing of leaf (chlorosis), death (necrosis), lesions, malformations, malfunctions, or decrease growth and health (Hale & Orcutt, 1987). However, there are several differ of nutrient deficiencies that can be observed on the pine trees as shown below (Table 3).

Table 2: **The visual symptoms of plant nutrient deficiencies in nursery and landscape plants**

Nutrient	Deficiency symptoms
Nitrogen (N)	• Leaves turn light green to yellow or become necrotic and drop off. • Plants are stunted. • Secondary shoot development is poor.
Phosphorus (P)	• Growth is stunted • Old leaves initially dark green • Older leaves may turn purple. • Leaf tips look burnt, followed by older leaves turning a dark green or reddish-purple.
Potassium (K)	• Leaf margins turn chlorotic and then necrotic • Scattered chlorotic spots often occur on the leaves, and these spots may later turn necrotic. • Older leaves may wilt, look scorched. • Interveinal chlorosis begins at the base, scorching inward from leaf margins.
Magnesium (Mg)	• Interveinal chlorosis on older leaves.
Calcium (Ca)	• Light green color or uneven chlorosis of young leaves • Margins of young leaves fail to form (strap-leaves) • Growing points of stems and roots cease to develop (blunt end) • Poor root growth and roots short and thickened.
Sulfur (S)	• Uniform chlorosis first appearing on new leaves.
Iron (Fe)	• Interveinal chorosis of new leaves followed by complete chlorosis and/or bleaching of new leaves
Zinc (Zn)	• Interveinal chlorosis of new leaves with some green next to veins • Short internodes and small leaves; rosetting or whirling of leaves.
Manganese (Mn)	• Interveinal chlorosis of new leaves with some green next to veins and later with grey or tan necrotic spots in chlorotic areas.
Copper (Cu)	• Interveinal chlorosis of new leaves with tips and edges green, followed by veinal chlorosis and finally rapid and extensive necrosis of leaf blades.